S303 Dust Monitor
User Manual

Distributor

Version 1.6
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1. INTRODUCTION

This manual describes how to install and use SINTROLôs digital triboelectric dust monitor S303.

This manual is intended as a guide to the use and installation of the product. Sintrol shall not be liable for any loss or damage whatsoever arising from use of any information or details therein, or omission or error in this manual, or any misuse of the product.

1.1 Safety

Model LV requires a 115 VAC, 50/60 Hz power supply and model HV a 230 VAC, 50/60 Hz power supply. In both cases, the power supply must be considered as potentially lethal and all suitable precautions must be taken whenever the cover of the unit is removed. DC model requires 24 VDC power supply.
S300 Series dust monitors are virtually maintenance free. Under no circumstances should the user attempt to replace any components or the PC board. If, for some reason the monitor fails to operate, contact your local distributor or the manufacturer.

Take appropriate precautions when installing the monitor:
Unless the process conditions are known to be entirely safe, suitable precautions must be taken before any entry is made into the duct for installation or maintenance purposes.

- The unit may be installed in ducting, containing particulate, hazardous to health.
- The particulate may be inflammable, explosive or toxic
- The gas can be hot and pressurised

The S300 Series dust monitors do not have an internal circuit breaker. The customer has to install a separate circuit breaker to the power cable to ensure that the power can be isolated. Electrical installations must be carried out in a manner to satisfy all applicable, local regulations.

It is essential that the unit is correctly grounded! **(See section 3.1)**

1.2 Product overview

The S303 Trend monitor is a microprocessor-based, self-adjusting device, equipped with two alarm relays and a 4-20 mA signal output is designed for trend or filter bag leak detection. It can also be used to detect blockage or stoppage in pneumatic transport and bulk solids handling. It is a compact unit with the sensor and control units built into one IP65 enclosure that has been specifically designed for easy installation and operation. The standard model is designed for applications at up to 2 bar and 300 °C. High-temperature (HT) models are available for at up to 700 °C.

1.3 How does it work?

The model S303 Trend monitor use proven and reliable triboelectric technology where the interaction of particles with the sensor rod causes a small electrical charge to pass between the particulate and sensor.
It is this small electric charge that provides the signal monitored by the electronics, the signal generated is proportional to the dust level even if particles accumulate on the sensor. Experience has shown that this method of monitoring dust level in gasses, offers accurate results with minimum maintenance.

2. INSTALLATION

2.1 Selecting the installation location

The best location for installation of the units of the S300 Series is in a section of duct where the particulate has an even distribution and the flow is laminar. This is to ensure that the sensor rod comes into contact with a representative flow of particles.
The ideal position would be in a section of duct that has no bends, valves, dampers or other obstructions for a distance equal to at least three duct diameters downstream or upstream (preferable 5 x duct diameter).

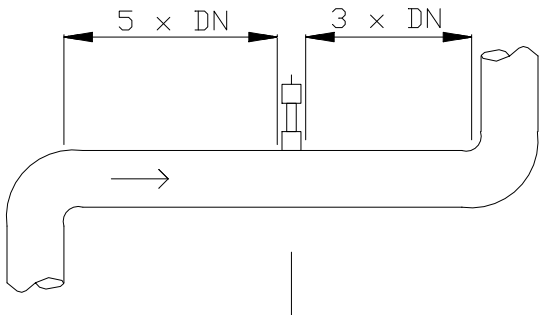


Figure 1. Recommended distances to duct bends

In some applications, a compromise must be made and the sensor will have to be fitted in a position that satisfies the majority of above requirements. The units of the S300 Series must be attached to metal ductwork so that they will be electrically shielded from interference and be provided with a ground reference. For non-metal ducts, a section of the duct, approximately five diameters in length, should be covered with a metal foil or fine-mesh outside of the duct.

The units must not be installed in direct sunlight or in areas where the ambient temperature is above 45ºC. Please contact your local distributor or Sintrol if you require further advice.

Figure 2. S303 Trend Monitor

The unit shall be installed in a position, where the gas flow passes the sensor rod in a 90° angel.
In round cross-section ducts, the unit can be installed in any position above the horizontal axis (between 9 o'clock and 3 o'clock).
For square cross-section ducts, the unit must be positioned in the middle of the top or in the middle of one of the sides. In all cases, the tip of the sensor rod must extend at least 1/3 of the diameter of the duct. Depending on the dust concentration, the probe length could vary from 1/3 to 2/3 of the duct diameter. As a rule of thumb: the lower the dust concentration the longer the probe.
If possible the unit shall be installed in a position where the duct pressure is negative.
If installed downstream an electrostatic precipitator (ESP), the distance from the ESP should be at least 20 m. Although the sensor (lengths less than 1m) is not affected by vibration, very high vibration levels should be avoided.

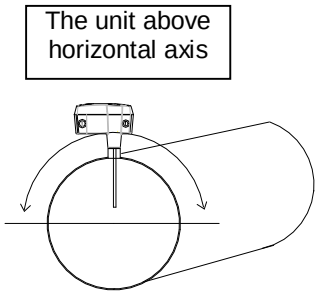


Figure 2a. Round cross-section duct

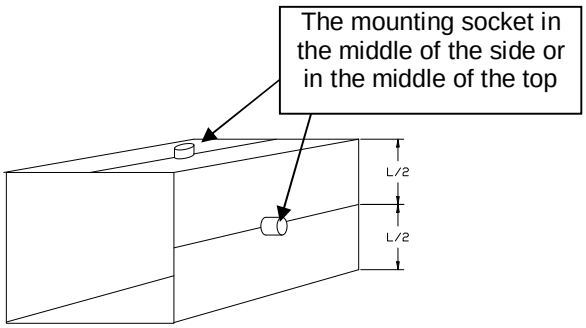


Figure 2b. Square cross-section duct

2.2 Installing the sensor

Once the location of the unit has been selected, the mounting socket must be welded to the pipe or duct. **To do this, first cut a hole in the duct slightly larger than the OD of the mounting socket, 38 mm.** The socket must be perpendicular to the flow in the duct. Make sure the socket is in the right position and make an airtight welding
After welding the socket in position, insert the sensor.

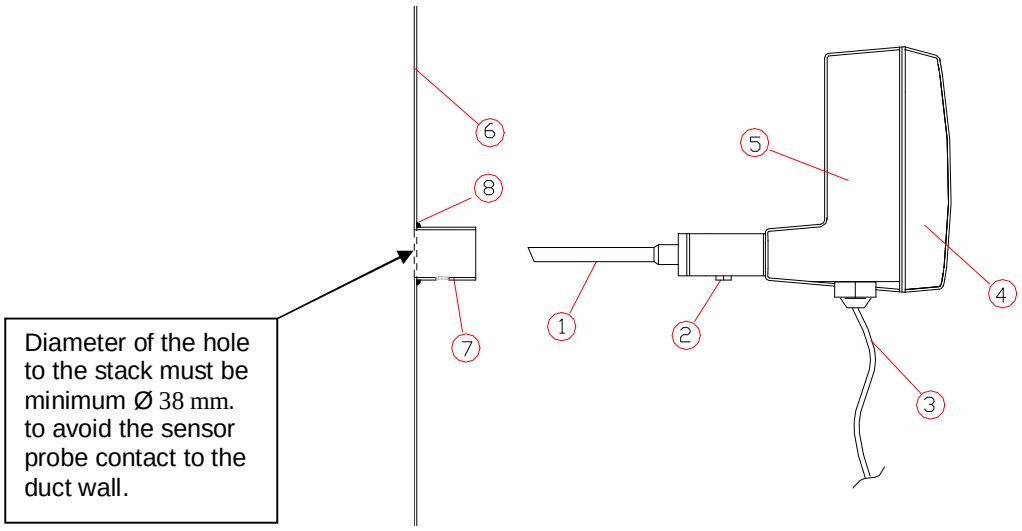


Figure 3a. Sensor installation

1. Probe
2. Fixing screw
3. Cables (mains and signals)
4. Cover
5. Enclosure
6. Duct wall
7. Socket
8. Weld

When installing HT or HT/MP sensor it is important to take care that the ambient temperature will not increase above 45 degree. The electronics inside of enclosure is sensitive for temperature.
To do the installation, first cut a hole in the duct slightly larger than the OD of the mounting socket, 38 mm (HT) 45 mm (HT/MP). The socket must be perpendicular to the flow in the duct. Make sure the socket is in the right position and make an airtight welding. After welding the socket in position, insert the HT or HT/MP sensor.

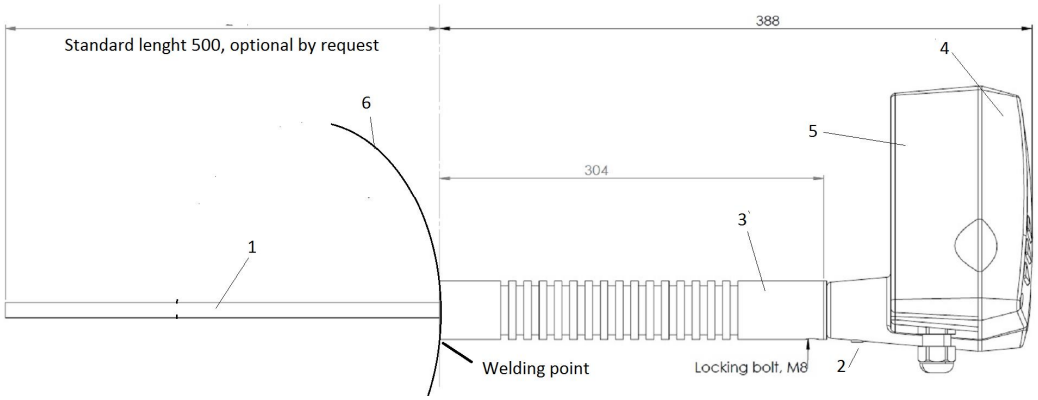


Figure 3b. Monitor installation with HT or HT/MP sensor

1. Probe
2. Fixing screw
3. Cooling extender
4. Cover
5. Enclosure
6. Duct

WRONG SOCKET INSTALLATION

Figure 3b. **Wrong socket installation**,
THE DIAMETER OF THE HOLE MUST BE MINIMUM 38 MM

3. WIRING OF POWER AND OUTPUT CIRCUITS

3.1 AC- power connectors (X3)

Voltage: 230 VAC +/- 20 V or 115VAC +/- 10V or 24 VDC

Frequency: 45 Hz é 65 Hz (AC models)
Power cable: 3 x 1,5 mm^2

Connect a 115/230 VAC power supply or a 24 VDC power supply to connector X3 (see Figure 5). Push the connector lever until the connector slot jaw opens; insert the power supply lead, then release the lever. Attach the ground wire to the GND screw.

AC1	- power input	(- terminal in 24 VDC model)
AC2	+ power input	(+ terminal in 24 VDC model)
GND	Protective earth terminal.	

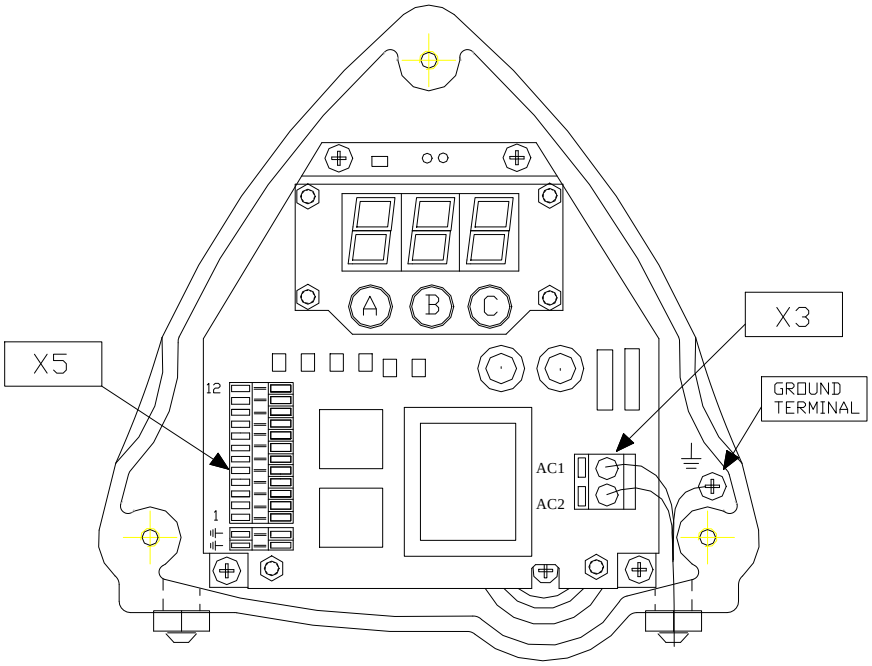


Figure 4. Wiring

3.2 Signal connector (X5)

One or more of the following functions are available, depending of the product model:

Relay output 1: Volt free SPDT contact, max. load 5 A @24 V AC/DC
Relay output 2: Volt free SPDT contact, max. load 5 A @24 V AC/DC

Analogue output: 4-20 mA, active, isolated. isolation Voltage 500 V.

Serial communication: RS-485 isolation Voltage 500 V.

Connect the signal wires to connector X5 (see Figure 5a and 5b). Push the connector lever with a screw driver, until the connector slot jaw opens, insert or remove the wire, then release the lever.

Slot 1	Relay1 normally closed (NC) terminal.
Slot 2	Relay1 common (C) terminal.
Slot 3	Relay1 normally open (NO) terminal.
Slot 4	Relay2 normally closed (NC) terminal.
Slot 5	Relay2 common (C) terminal.
Slot 6	Relay2 normally open (NO) terminal.
Slot 7	4-20 mA (+) more positive terminal, active output.
Slot 8	4-20 mA (-) more negative terminal, active output.
Slot 9	RS 485 output (+) terminal
Slot 10	RS 485 output (-) terminal
Slot 11	RS 485 input (+) terminal (D+/TX+)
Slot 12	RS 485 input (-) terminal (D-/TX-)

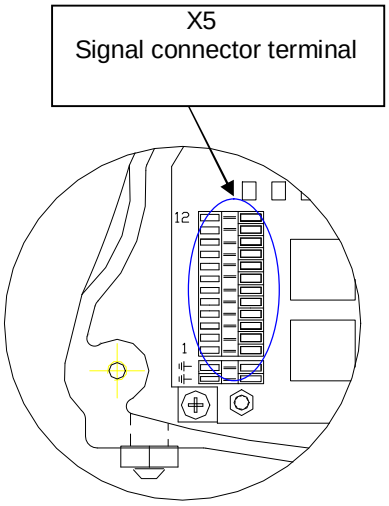


Figure 5a. Signal connector

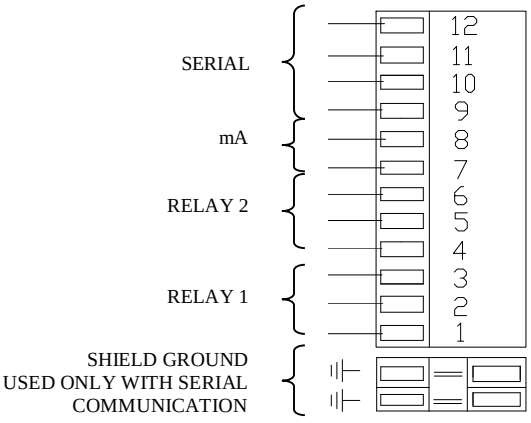


Figure 5b. Signal connector X5 wiring

4. TECHNICAL SPECIFICATION

Measured objects:	Solid particles (dust) in a gas stream
Particle size:	0.3 μm or larger
Measurement range:	0.1 mg/m^3 to 1 kg/m^3
Process Conditions:	
Temperature:	Max. 100°C (standard) / 200-350°C (optional)
Pressure:	Max. 200 kPa
Gas velocity:	Min. 4 m/s
Humidity:	95 % RH or less (non-condensing)
Input surge voltage:	Max. 100 V
Measurement principle:	Electrostatic charge detection
Output damping time:	10 to 180 seconds
Output signals:	Isolated 4-20 mA Relay 5 A, 24 V AC or DC
Ambient conditions:	
Temperature:	-20 to + 45^{o}C
Humidity:	95% RH (non-condensing)
Vibration:	5 m/s^2 or less
Materials:	
Probe:	SS 316L
Insulation of sensor:	PEEK (300 ^{o}C), Teflon (100 ^{o}C)
Enclosure:	Aluminium alloy
Power Supply:	115 VACor 230 VAC or 24 VDC
Power consumption:	8 W AC models, 3 W 24 VDC model
Wiring connections:	DIN PG11 port for power cables DIN PG11 port for signal cable
Weight:	2.3 kg

Range setup options:

Normal measuring range:	-automatic, based on average measured dust flow
Extended measuring range:	- (option) set at factory
Alarm threshold:	Adjustable via internal keys or via serial port.
Zero point offset trim:	Automatic

This instrument conforms to the following standards

CE	EN 61010-1:2001 Safety, LVD
	IEC 61326-1:2005 (First Edition) Electromagnetic Compatibility EMC
	Mechanical tests: IEC 60068-2-6, TEST Fc(1995-03), IEC 60068-2-29, TEST Eb

5. DIMENSIONS

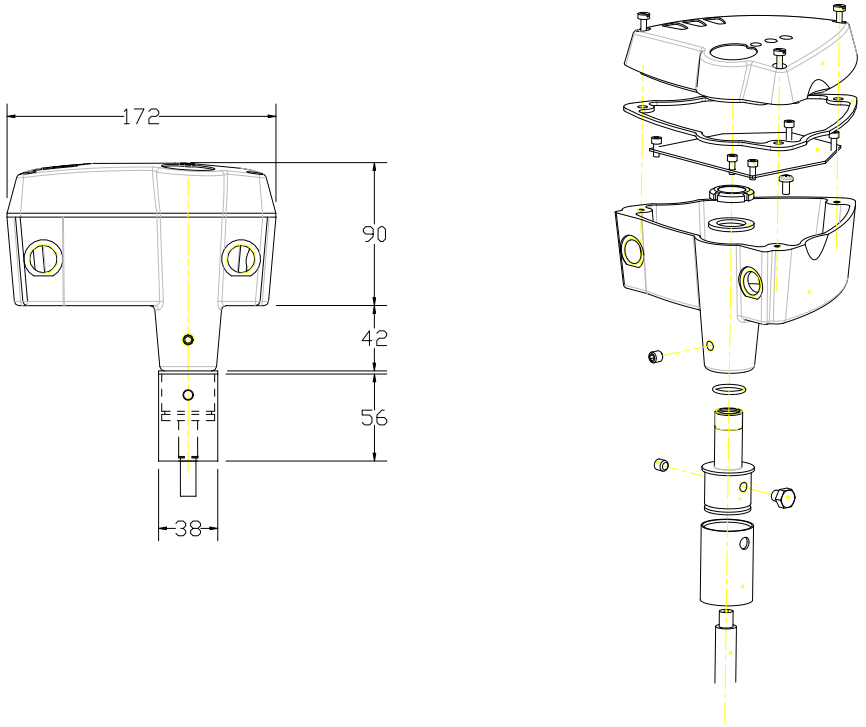


Figure 6. Dimensions and structure of S300 series Dust Monitor enclosure

6. OPERATION

6.1 Operation of the monitor

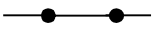
The S300 Series Dust Monitor measures the dust level in a gas stream by monitoring electrostatic discharge when charged dust particles hit or pass by the probe. It may have a 4é 20 mA output (S302/S303), and/or two relay contact alarm outputs (S301, S302 and S303).

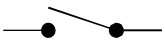
The signal generated by the electrostatic loaded particles can be averaged with a user selectable time constant to remove the effect of short variations.
The alarms are arranged such that Alarm 1 is a low alarm. Alarm 2 is a high alarm. The alarms can be delayed by means of a common time delay, the time is user selectable in the range 0 to 180 seconds in 10 seconds increments.
The alarm threshold for each of the two alarms, are adjustable between 1 to 99% of the measuring range.

All the user selectable parameters are factory set to default values shown in table 1 on page 16.

6.2 Relay connections

There are four different setup configurations depending on how the relays are connected.

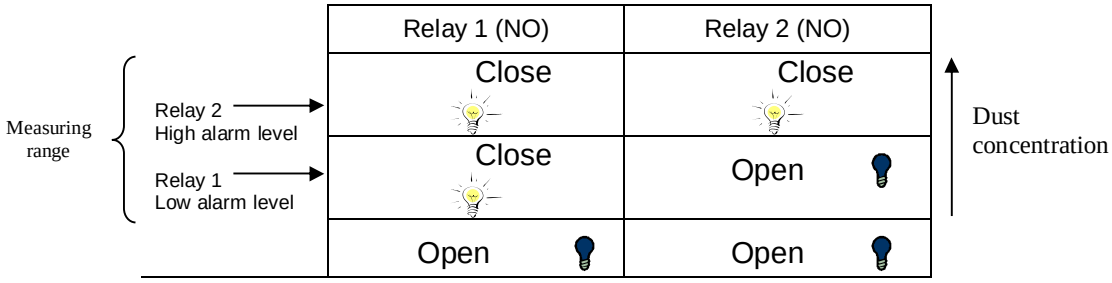
Light bulb indication is ON when relay contact spring is closed. 

Light bulb indication is OFF when relay contact spring is open. 

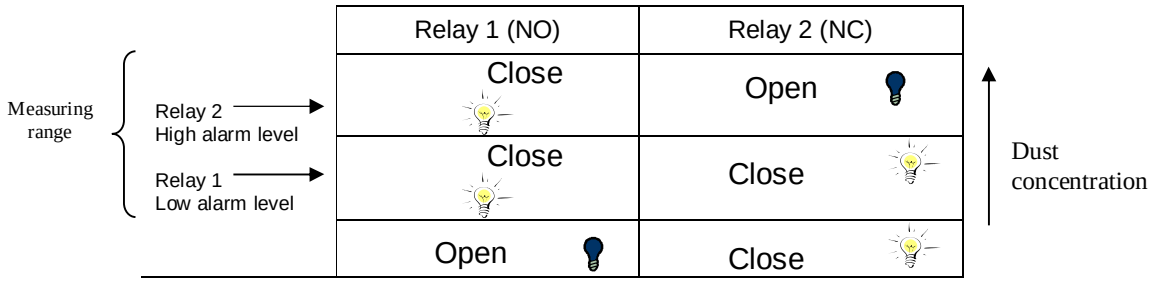
Low alarm level and High alarm level are dust levels where relays change state.

Setup configuration 1:

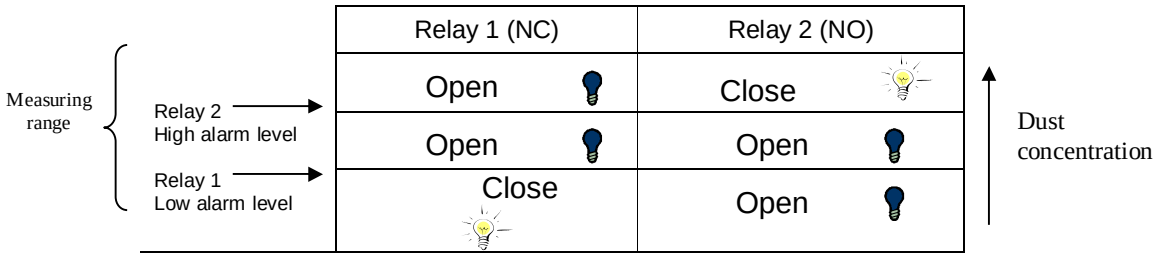
Both relays connected to Normally Open (NO)



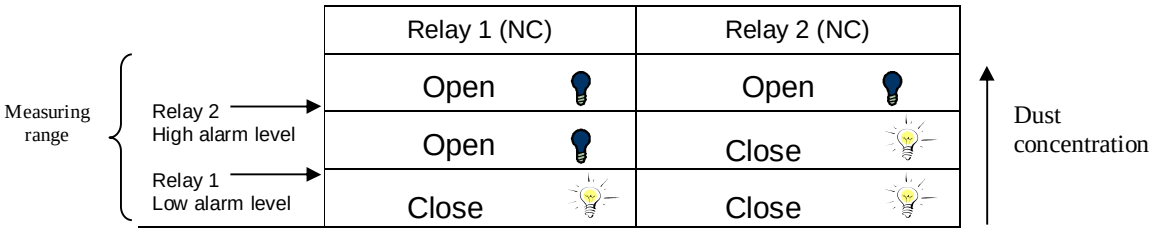
Setup configuration 2:
Relay 1 Normally Open (NO), Relay 2 Normally Close (NC),



Setup configuration 3:
Relay 1 Normally Close (NC), Relay 2 Normally Open (NO),



Setup configuration 4:
Both relays connected to Normally Close (NC)



6.3 How to change parameter values

Remove the cover of the monitor. You will see the front panel, display unit and three parameter adjustment keys. (A, B and C, figure 8).

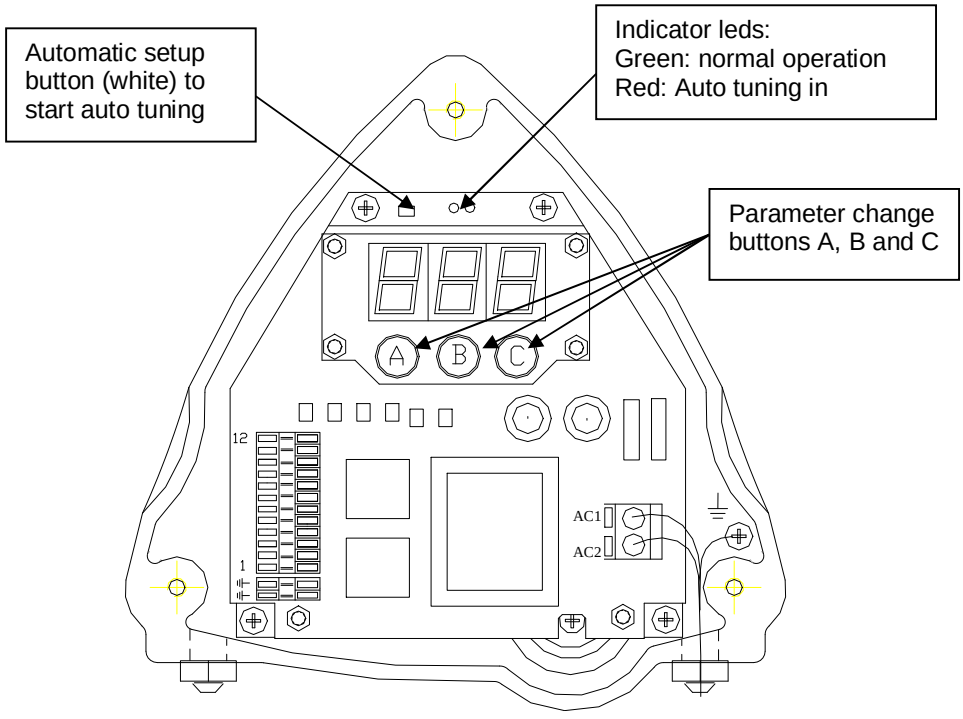


Figure 7. S300 series Dust Monitor front panel

Press the left key (A), below the display, until the left digit indicates the number of the parameter you wish to change, 1 é 8. (see Table 1).

The two rightmost display digits now show the parameter values. By pressing the middle key (B) and right key (C), the value for each parameter can be altered as indicated in table 1.

When you have selected all the parameters push the leftmost (A) key again until the display left digit shows number 8. Push one of the other keys (B or C) to save all the parameters to EEPROM.

NOTE: Change all the required parameters before saving them. If you decide not to save the parameters you have changed, push the left key (A) again. Changed parameters should be saved to EEPROM to make sure parameters remain unchanged after power cut.

PARAMETER CHANGE TABLE

PARAMETER	DISPLAY LEFT NUMBER	RANGE	KEY EFFECT KEY B	KEY EFFECT KEY C	FACTORY DEFAULT
Relay 1 trig value	1	1é 99%	add 10%	add 1%	5%
Relay 2 trig value	2	1é 99%	add 10%	add 1%	60%
4 mA trim	3	-	increase current	decrease current	set to 4 mA
20 mA trim	4	-	increase current	decrease current	set to 20 mA
Relay filter time constant	5	10é 180 s	add 10s	-	0
Current filter time constant	6	10é 300 s	add 10s	-	0
Percent level of full Range	7	10-50 %	increase 10 %	decrease 10 %	20 %
Manual range	8	0 é 5	Next range	Previous range	0
Save parameters	9 (-SP)	- -	save all	save all	-

Table 1. Parameter change table

Parameter 1 and 2 - Alarm relay 1 and Alarm relay 2 threshold

Threshold for alarm relay 1 and relay 2 can be selected as a percentage of the output range. You may increase or decrease the trig value by pressing the keys. The percentage is displayed by the two rightmost display digits.

Parameter 3 - Analog output zero adjustment

If needed, output zero can be adjusted to 4 mA.
Allow 30 minutes warm up time before trimming the mA output.

Parameter 4 - Analog output span adjustment

If needed, output span can be adjusted to 20 mA.
Allow 30 minutes warm up time before trimming the mA output.

Parameter 5 - Alarm Relay delay time

Time delay for the two alarm relays can be set between 0 and 180 seconds with 10 seconds increment.
The time set is common for both alarm relays

Parameter 6 - Analog output damping

If the dust reading is oscillating , the analog mA output can be averaged by the filter time constant, the filter time can be set between 0 and 300 seconds with 10 seconds increment

Parameter 7 - Normal process operation point

If the customer wants to change the normal process operation point. Factory default value for parameter 7 is 20 % of monitor's full range. The normal operation point percentage of full range can be adjusted from 10% to 50%.

6.4 Parameter 8 ï Manual range option

Parameter 8 changes the manual range. By pressing key B or C desired range can be selected. Parameter 8 value 0 means normal mode and auto setup is needed to do.
All fixed ranges (values from 1 to 5) do not need auto setup on commissioning because range settings are set at factory.

Parameter 8 value	Gain	Mode	Dust level	Auto setup
0	Dynamic 5x	Automatic	all concentrations	auto setup is needed to do
1	1x	fixed	Very high dust concentration	NOT NEEDED
2	10x	fixed	High dust concentration	NOT NEEDED
3	100x	fixed	Moderate dust concentration	NOT NEEDED
4	1000x	fixed	Low dust concentration	NOT NEEDED
5	10000x	fixed	Very low dust concentration	NOT NEEDED

6.5 Parameter 9 ï Save parameters

Parameter number 9 saves all the parameters (-SP in the display).
Press button B or C to save parameter changes. The dust monitor goes to the normal measuring mode after pressing B or C.

7. AUTOMATIC SETUP

To be able to detect variations in dust flow, and to set the alarm so that it will go off if there is excessive dust flow, **you must determine the typical dust flow in the application when the process is operating normally.**

The unit has an AUTOMATIC SETUP function. With this, you can set the measuring range of the dust monitor so that a typical dust flow in the application corresponds to 20% of the emission monitor output full scale

For AUTOMATIC SETUP you need to know that the process is running with **a normal dust flow rate.** Then remove the cover of the unit, and initiate AUTOMATIC SETUP by pressing the small button near the indicator lamp, on the lower printed circuit board (see Figure 9). NOTE: the indicator lamp must be green before you press the key.

The unit starts collecting dust flow data. This takes from about one hour (typically 40-60 minutes). The three digit display counts down to zero, and the indicator lamp remains red as long as data are being collected. To avoid interference from background electrical noise, you should replace the cover of the unit after having initiated the AUTOMATIC SETUP. After an hour, the setup is ready and the unit returns to normal operation. If your environment is not electrically noisy, you may check the indicator lamp. It will turn to green, when setup is ready.

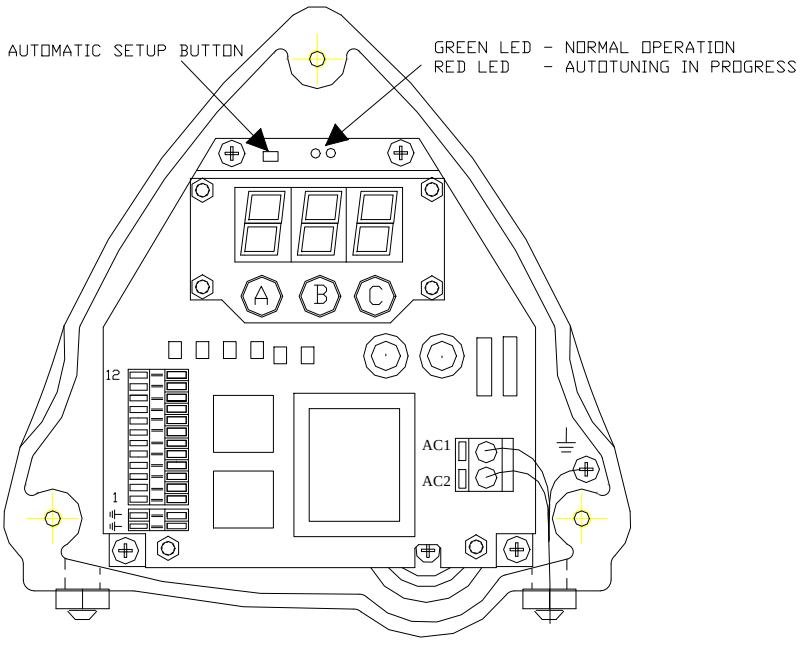


Figure 8. Automatic setup button and operation indicator led

AUTOMATIC SETUP

1. Ensure that the process is in normal conditions.
2. Make sure that the monitor has been powered for at least 15 minutes in order to warm up and stabilise.
3. Press the AUTOMATIC SETUP BUTTON (the white button on lower printed circuit board)
4. Make sure that green LED indicator turns red
5. Mount the cover of enclosure and tighten it and wait for about 45 minutes until the LED turns green indicating that the Automatic Setup sequence has finished
6. The unit is ready to use

8. MAINTENANCE

S303 Dust Monitor needs very little maintenance. To achieve maximum reliable operation the recommended maintenance interval is 2 months.

Maintenance is done by removing the unit from the socket and cleaning the probe to prevent signal leakage to ground.

If the particles in the gas are sticky and tend to build up, use air purge adaptor and compressed clean and dry process air to keep the sensor base clean.
Inside enclosure maintenance is not needed.

9. TROUBLESHOOTING

The Monitor is not giving output signal

1. Check the power and signal wiring is right connected.

2. Check there is power on and three digit display is showing measurement readings and it is possible to change and save parameters.

3. Check the parameter settings

If the monitor is not giving any output signal after checks 1, 2 and 3 contact your local distributor.

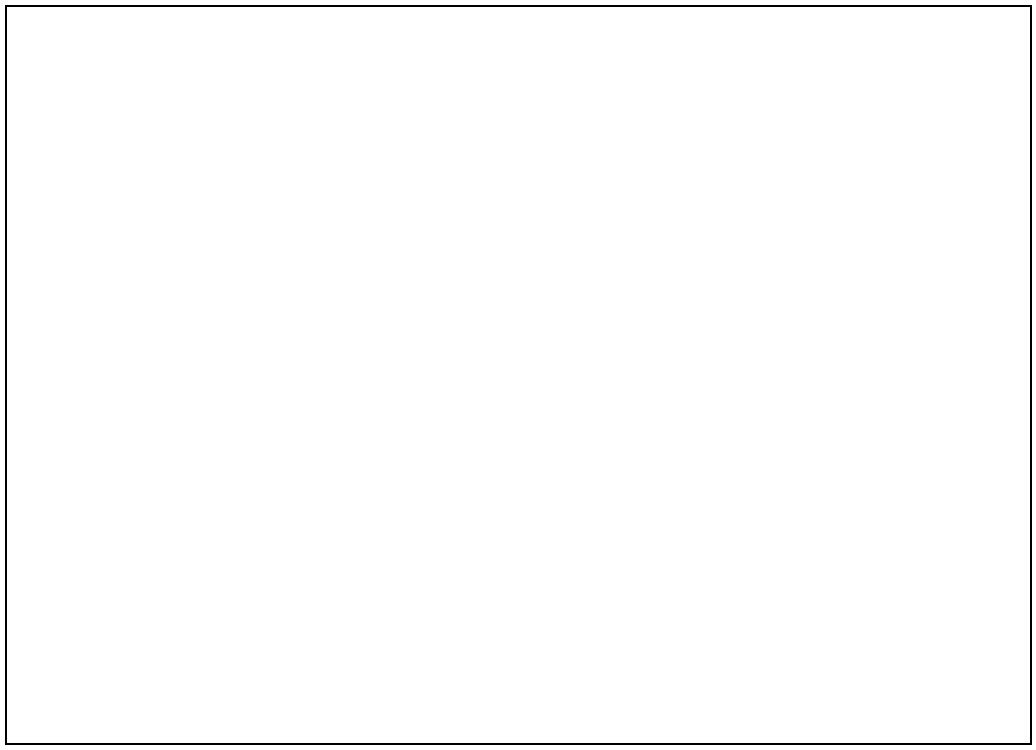
The Monitor is giving 4 mA or 20 mA continuously after auto setup procedure.

1. Check that there is normal process going on and during auto setup there were normal operation conditions. Check that the dust concentration really is not the zero or over the range.

2. Check the power and signal wiring is right connected

3. Check the signal is not leaking to ground.
   - Contact between sensor probe and duct wall is not allowed.
   - The gas should not be condensing
   - Check the sticky dust does not build up to the base of the sensor and does not make the bridge between sensor probe and duct wall. If the dust is bridging, the air purge is needed.
4. Check the parameter settings

NOTES



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